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09/822,414	04/02/2001	Hiroya Kirimura	P107351-00011	9442

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EXAMINER

SONG, MATTHEW J

ART UNIT	PAPER NUMBER
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1792

MAIL DATE	DELIVERY MODE
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11/26/2007

PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary

Application No.

09/822,414

Applicant(s)

KIRIMURA ET AL.

Examiner

Matthew J. Song

Art Unit

1792

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 10 September 2007.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 26-45 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 26-45 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
- ☐ Certified copies of the priority documents have been received.
 - ☐ Certified copies of the priority documents have been received in Application No. _____.
 - ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO/SB/08)
Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Claim Rejections - 35 USC § 103

1. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

2. Claims 31, 33-34 and 37-40 are rejected under 35 U.S.C. 103(a) as being unpatentable over Asakawa et al (US 5,795,385) in view of Zhang et al (US 5,766,344).

In a method of forming a single crystalline thin film by beam irradiation, note entire reference, Asakawa et al teaches forming an amorphous silicon film on a substrate using plasma chemical vapor deposition, this clearly suggests applicant's prefilm, while simultaneously irradiating the substrate with beams of low energy gas, this clearly suggests applicant's energy beam (col 4, ln 30-67). Asakawa et al also teaches the amorphous thin film is converted to form a single crystalline film (col 4, ln 30-50). Asakawa et al teaches the substrate can be scanned by a

substrate moving means, whereby it is possible to form a single crystalline thin film having high homogeneity on a long substrate (col 10, ln 5-45; Eleventh Preferred Embodiment). Asakawa et al also teaches it is possible to facilitate formation of an amorphous thin film by intermittently applying beams from an ion source while regularly supplying a reaction gas and rotating the substrate during application pauses (col 12, ln 1-50). Asakawa et al also teaches neon ions can be accelerated to 200-600 eV by an ion source **83** (col 23, ln 20-55). Asakawa et al also teaches a plasma CVD process (col 32, ln 1-67). Asakawa et al also teaches a reaction chamber coupled to a vacuum unit (col 27, ln 1-15), this clearly suggests applicant's vacuum chamber. Asakawa et al teaches formation of an amorphous film by intermittently applying beams from an ion source while supplying reaction gas. Asakawa et al teaches a pre-film of the crystalline silicon film is formed on the target surface while emitting an ion beam to the substrate in the step of forming the pre-film by the film forming device (col 4, ln 50-67).

Asakawa et al does not teach using an energy beam consisting of a laser beam or an electron beam to produce an intended crystalline silicon film.

In a method of forming a semiconductor device by crystallizing silicon, note entire reference, Zhang et al teaches a method of forming a crystalline silicon film comprising a plasma chemical vapor deposition (CVD) apparatus, this reads on applicants' film forming device, provided with a window of quartz so that a laser can be irradiated from the outside, this reads on applicants' laser beam irradiating device (col 5, ln 60 to col 6, ln 20). Zhang et al also teaches a non-crystalline silicon hydride semiconductor layer **13** was formed by plasma CVD and crystallization of the sample was effected by an excimer laser irradiation (col 5, ln 5-61 and claim 1). Zhang et al also teaches the processes from the film forming to the laser irradiation may

be effected in succession without a transfer of the sample instead of using a chamber exclusively used in the laser annealing (col 5, ln 60 to col 6, ln 10), this clearly suggests applicants' producing the intended crystalline silicon film from the pre-film by irradiating the pre-film in the vacuum chamber subsequently to the formation of the pre-film.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify Asakawa et al by crystallizing with laser light as taught by Zhang et al to improve the crystallinity of the silicon film.

Referring to claim 33, Asakawa et al discloses supplying a reaction gas onto a substrate allowing no crystallization of the material with plasma CVD while simultaneously irradiating the substrate with beams of low energy gas to convert the amorphous film to a crystal having a regulated crystal orientation (col 4, ln 30-67). Asakawa et al does not disclose a dehydrogenation process, this reads on applicant's limitation of without conducting a dehydrogenation process. Furthermore, the crystallization of the amorphous film with the energy beam occurs simultaneously with the formation of the amorphous film; therefore a dehydrogenation process cannot occur and a dehydrogenation process, as described by applicant's, requires a separate heat treatment, which is not taught by Asakawa et al.

Referring to claim 34, Asakawa et al teaches the substrate can be scanned by a substrate moving means, whereby it is possible to form a single crystalline thin film having high homogeneity on a long substrate (col 10, ln 5-45; Eleventh Preferred Embodiment), this reads on applicant's concurrently operating the energy beam device to irradiate

Referring to claim 31, Asakawa et al teaches plasma CVD (col 33, ln 20-45).

Referring to claims 37-38, Asakawa et al teaches formation of an amorphous film by intermittently applying beams from an ion source while supplying reaction gas, this reads on applicant's ion beam is emitted to the target surface of the substrate in an initial stage of the forming of the pre-film.

3. Claim 26-30, 35-36 and 41-45 are rejected under 35 U.S.C. 103(a) as being unpatentable over Asakawa et al (US 5,795,385) in view of Zhang et al (US 5,766,344) as applied to claim 31, 33-34 and 37-40 above, and further in view of Selvakumar et al (US 5,633,194).

The combination of Asakawa et al and Zhang et al teaches all of the limitations of claim 35, as discussed previously in claim 33, an ion beam is emitted to the target surface of the substrate from the ion source prior to the step of forming the pre-film

In a method of forming epitaxial grown Si utilizing ion beams (col 1, ln 35-65), Selvakumar et al teaches in-situ cleaning of a substrate surface by argon ion bombardment prior to the start of deposition, where a 200 eV argon ion beam was used to sputter clean the substrate in a necessary step which significantly influences the quality of a grown film by removing native oxide. Selvakumar et al also discloses an inexpensive ion beam vapor deposition technique used to grow silicon films, where an ion source 13 was used to ionize a gas to accelerate an ion beam towards a substrate with a current between 30-1000 eV using high purity argon and silane gases as sources for the ion beam (col 6, ln 20-65; col 7, ln 1-67). It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Asakawa et al and Zhang et al with Selvakumar et al to clean the substrate.

Referring to claim 26-29, the combination of Asakawa et al, Zhang et al and Selvakumar et al teaches an ion beam where a current can be adjusted between 30-1000 eV and a cleaning at 200 eV. Overlapping ranges are held to be obvious (MPEP 2144.05). Furthermore, It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Asakawa et al, Zhang et al and Selvakumar et al by optimizing the emission energy by conducting routine experimentation.

Referring to claim 30, Overlapping ranges are held to be obvious (MPEP 2144.05).

4. Claim 32 is rejected under 35 U.S.C. 103(a) as being unpatentable over Asakawa et al (US 5,795,385) in view of Zhang et al (US 5,766,344) as applied to claim 31, 33-34 and 37-40 above, and further in view of Ahn et al (US 5,470,619).

The combination of Asakawa et al and Zhang et al teaches all of the limitations of claim 32, as discussed previously, except plasma CVD using hydrogen gas.

In a method of forming amorphous silicon films using plasma CVD, note entire reference, Ahn et al teaches a substrate placed in a PECVD chamber heated from room temperature to 600°C in an atmosphere of a source gas to deposit an amorphous silicon film, thereon. Ahn et al also teaches using Si₂H₆ or H₂ diluted SiH₄ as a source, which is less expensive.

It would have been obvious to a person of ordinary skill in the art at the time of the invention to modify the combination of Asakawa et al and Zhang et al by using a H₂ diluted SiH₄ source gas because it is conventionally known in the art to be used in plasma CVD processes to form amorphous silicon and it is less expensive, thereby reducing cost.

Response to Arguments

5. Applicant's arguments filed 9/10/2007 have been fully considered but they are not persuasive.

Applicant's argument that Asakawa does not teach an energy beam is applied in the same first direction of the ion beam is noted but not found persuasive. Applicant alleges that Asakawa teaches beams of material from directions which are perpendicular to a plurality of densest crystal plane citing column 4, lines 30-67. However, the Examiner also cited column 10, lines 5-20 and column 59, lines 5-65, which teaches a substrate can be scanned by the substrate moving means and a beam focusing means for bringing sections of the gas beams into strip shapes and scanning direction is perpendicular to the strip of the atom current. Therefore, the strip of the atom current clearly suggests applicant's first direction and the scanning direction is perpendicular to the strip, thus the scanning direction clearly suggests applicant's second direction. Furthermore, Asakawa teaches a linear region receiving the atom currents and the substrate is moved perpendicular to the beam and due to such scanning of the substrate, thus it is possible to uniformly irradiate the substrate (col 51, ln 60 to col 52, ln 5), which clearly suggests applicant's first and second directions because the first direction is the direction of the linear region and the substrate is scanned in a direction perpendicular to the linear region, which clearly suggests the second direction. The same arguments apply to the remarks for claims 35-36.

Applicant's argument that Asakawa does not teach irradiating the pre-film with the energy beam while moving the substrate is noted but not found persuasive. Asakawa teaches a linear or strip shaped region receiving the atom currents and the substrate is moved perpendicular

to the beam and due to such scanning of the substrate, it is possible to uniformly irradiate the substrate (col 51, ln 60 to col 52, ln 5 and col 59, ln 50-67). Therefore, Asakawa clearly suggests irradiating with beams while moving.

In response to applicant's arguments against the references individually, one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Zhang is not relied upon to teach the first and second direction, nor irradiating while moving. These features are taught by Asakawa.

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

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7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Matthew J. Song whose telephone number is 571-272-1468. The examiner can normally be reached on M-F 9:00-5:00.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Michael Barr can be reached on 571-272-1414. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

Matthew J Song
Examiner
Art Unit 1792

MJS
November 19, 2007

*/Robert Kunemund/
Robert Kunemund
Primary Examiner
TC 1700*